

REMARKS

Claims 1-39 are pending in the application, with claims 16-39 having been withdrawn from consideration.

Claim 9 has been amended in order to more particularly point out, and distinctly claim the subject matter to which the Applicants regard as their invention. It is believed that this Amendment is fully responsive to the Office Action dated **February 6, 2003**.

Claim Rejections under 35 USC §112

Claims 9-15 are rejected under 35 USC §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The claim has been amended, as needed, to overcome this rejection. It is believed that the following explanation regarding the claimed invention would clarify many issues asserted in this rejection. Reconsideration and withdrawal of this rejection are respectfully requested.

Please note that the first and second active regions are the device regions 11A and 11B, respectively, shown in FIGs. 4 through 6D and that “a first gate electrode...to be capacitive-coupled...” means “...so that capacitive coupling is formed between the first gate electrode (13A) and the embedded diffusion region (11C) view the insulating film (12Ac)...”

Claim Rejections under 35 USC §103

Claims 1-15 are rejected under 35 USC §103(a) as being unpatentable over Applicant Admitted Prior Art (APA) in view of Fastow et al. (U.S. Patent No. 6,294,430).

As described in page 8, lines 25-34 and page 14, lines 4-19, of the written specification, the problem of the prior art lies in that the bird's beaks are formed in the device region (as well as in the memory cell region) so as to penetrate under the gate electrode so that a substantial change in the film thickness of the gate oxide (insulating) film occurs right under the gate electrode in the device region, causing a shift in the threshold characteristic from a desired value.

To eliminate this problem, according to the inventions of claims 1 and 9, "a semiconductor device in a device region" is provided so that "the gate insulating film is interposed between the substrate and the gate electrode to have a substantially uniform thickness" while "a nonvolatile memory device formed in a memory cell region" is provided so as to include "a bird's beak structure."

According to this configuration, the bird/s beak structure is prevented from forming under the gate electrode of the semiconductor device (MOS transistor) at the same time that the bird's beak structure is formed in the nonvolatile memory device (flash memory cell) . Since no bird's beak structure is formed in the semiconductor device, the threshold characteristic of the semiconductor device can be improved. Meanwhile, the reliability of the nonvolatile memory device can be ensured because the bird's beak structure is formed so as to cover the floating gate electrode with an oxide

main print:
No bird's beak
structure in the
device.

film. Thereby, the semiconductor integrated circuit device including the nonvolatile memory device and the semiconductor device according to the present invention is improved over the prior art.

On the other hand, Fastow merely proposes a flash memory device including bird's beaks, and fails to teach a semiconductor integrated circuit device that simultaneously includes a flash memory device having a bird's beak structure and a semiconductor device having no bird's beak structure formed therein, that is, a semiconductor device having a gate insulating film interposed between a substrate and a gate electrode with a substantially uniform thickness.

To assist the Office in obtaining a full understanding of the claimed invention, it should be noted that independent claim 1 is supported by way of an example in Figure 9 and associated written specification. There is indeed disclosed a semiconductor integrated circuit device comprising a substrate (11); a nonvolatile memory device (flash memory) formed in a memory cell region (Region A) of said substrate and having a multilayer gate electrode structure (16F) comprising a tunnel insulating film (12A) covering said substrate and a floating gate electrode (13A) formed on the tunnel insulating film (12A) and having sidewall surfaces covered with a protection insulating film (16s) formed of a thermal oxide film; and a semiconductor device (MOS transistor) formed in a device region (Regions B, C) of said substrate, the semiconductor device comprising a gate insulating film (12b) covering said substrate and a gate electrode (16B) formed on the gate insulating film, wherein a bird's beak structure is formed of a thermal oxide film (18) at an interface of the tunnel insulating film (12A) and the floating gate electrode (13A), the bird's beak structure penetrating into the floating gate electrode (13A) along the interface from the sidewall faces of the

floating gate electrode (13A); and the gate insulating film (12B) is interposed between said substrate (11) and the gate electrode (16B) to have a substantially uniform thickness.

Independent claim 9 is supported by way of an example in Figure 12 and associated written specification. There is indeed disclosed a semiconductor integrated circuit device comprising a substrate (11); a nonvolatile memory device (flash memory) formed in a memory cell region (Region A) of said substrate, the nonvolatile memory device comprising a first active region (11a) covered with a tunnel insulating film (12A); a second active region (11b) formed next to the first active region (11a) and covered with an insulating film (12A, 12C); a control gate formed of an embedded diffusion region (11c) formed in the second active region; a first gate electrode (13A) extending on the tunnel insulating film (12A) in the first active region (11a) and forming a bridge between the first and second active regions to be capacitive-coupled via the insulating film (12A, 12C) to the embedded diffusion region (11c) in the second active region (11b), the first gate electrode (13A) having sidewall faces thereof covered with a protection insulating film (18) formed of a thermal oxide film; and a diffusion region (11a, 11b, 11c) formed on each of sides of the first gate electrode (13A) in the first active region (11a); and a semiconductor device (MOS transistor) formed in a device region (Regions B, C) of said substrate, the semiconductor device comprising a gate insulating film (12B) covering said substrate and a second gate electrode (13B) formed on the gate insulating film (12B), wherein a bird's beak structure is formed of the thermal oxide film (18) at an interface of the tunnel insulating film (12A) and the first gate electrode (13A), the bird's beak structure penetrating into the first gate electrode (13A) along the interface from the sidewall faces

of the first gate electrode; and the gate insulating film (12B) is interposed between said substrate (11) and the second gate electrode (13B) to have a substantially uniform thickness.

Accordingly, it is believed that independent claims 1 and 9 are patentably distinguished over Fastow. All claims depending thereon, by virtue of inherency, are also patentably distinguished over Fastow. Reconsideration and withdrawal of this rejection are respectfully requested.

Conclusion

In view of the aforementioned amendments and accompanying remarks, claim 9, as amended, are in condition for allowance, which action, at an early date, is requested.


If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicants undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

Attached hereto is a marked-up version of the changes made to the claim by the current amendment. The attached page is captioned "**Version with markings to show changes made.**"

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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PATENT TRADEMARK OFFICE

Enclosures: Version with markings to show changes made

IN THE CLAIMS:

Please amend claim 9 as follows:

9. (Amended) A semiconductor integrated circuit device comprising:

a substrate;

a nonvolatile memory device formed in a memory cell region of said substrate,

the nonvolatile memory device comprising:

a first active region covered with a tunnel insulating film;

a second active region formed next to the first active region and covered with
an insulating film;

a control gate formed of an embedded diffusion region formed in the second
active region;

a first gate electrode extending on the tunnel insulating film in the first active
region and forming a bridge between the first and second active regions to be capacitive-coupled via
the insulating film to the embedded diffusion region in the second active region, the first gate
electrode having sidewall faces thereof covered with a protection insulating film formed of a thermal
oxide film; and

a diffusion region formed on each of sides of the first gate electrode in the first
active region; and

a semiconductor device formed in a device region of said substrate, the semiconductor device comprising a gate insulating film covering said substrate and a second gate electrode formed on the gate insulating film,

wherein a bird's beak structure is formed of [a] the thermal oxide film at an interface of the tunnel insulating film and the first gate electrode, the bird's beak structure penetrating into the first gate electrode along the interface from the sidewall faces of the first gate electrode; and

the gate insulating film is interposed between said substrate and the second gate electrode to have a substantially uniform thickness.